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*When Internal
Transfer Prices and
Costs Differ*

*How Stock Funding of
Depot-Level Repairables
Affects Decision Making
in the Air Force*

Frank Camm, H.L. Shulman

*Prepared for the
United States Air Force*

Project AIR FORCE

Preface

Currently the Air Force is implementing major changes in its internal organization and management, many directed by initiatives from the Office of the Secretary of Defense. One change to expand stock funding to include depot-level reparable sets an effective "exchange price" that wing commanders must pay for any maintenance-related services provided at the depot. In the past, these services were free. This change is intended to encourage wing commanders to become more cost-conscious about the services that they demand from depots.

Major changes like these under way are bound to create problems as they generate unanticipated and unintended effects. If these changes are to succeed in the long run, the Air Force must find ways to identify such unintended effects and use the information obtained to effectively adjust the new policies as they are implemented. With that objective in mind, this report identifies one particular unintended effect of expanded stock funding and explains why the change is not working as anticipated. This example is used to suggest how the Air Force should adjust more generally to the changes that it is currently experiencing.

This report should be of interest to anyone involved in the current implementation of Defense Management Report Decisions (DMRDs) and, in particular, the implementation of the Defense Business Operating Fund (DBOF) in the Department of Defense. More generally, it should interest analysts concerned with the design of internal transfer prices in large, complex organizations.

This report was produced by the Logistics Project of the Resource Management and System Acquisition Program of Project AIR FORCE, the Air Force's federally funded research and development center. It is being released at this time to provide a means for effective communication with Air Force organizations interested in this RAND project. RAND welcomes any comments or criticisms that readers may have. These should be directed to Frank Camm, the project leader.

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Summary

Typically large, complex organizations include many separate activities that provide goods and services to one another. Such organizations must develop methods to govern the relationships among these activities that promote the goals of the organization as a whole. The Department of Defense (DoD) faces this problem in the same way as any other large organization.

In the late 1980s, DoD began an effort to change dramatically the way it managed the relationships among its constituent activities. As part of that effort, DMRD 904 mandated in November 1989 that the Air Force should apply stock funding to the management of depot-level reparable (DLRs). A stock fund is a revolving working capital fund that facilitates transactions between depots and their customers. To use such a fund, the Air Force must establish an extensive system of internal transfer prices for depot services. The Air Force issued an implementation plan for such a system in November 1990 and is continuing to put it in place. This report presents an example of how the internal transfer prices being implemented under DMRD 904 affect substantive decisionmaking to raise doubts about the current approach to pricing and to suggest the need for an alternative approach.

Pricing Depot Services Under DMRD 904

As currently interpreted, DMRD 904 requires a depot to recover all of its costs through direct charges for the services it provides to other DoD organizations. Hence, the price for servicing depot-level reparable must cover (1) the estimated direct cost of repair, (2) the expected cost of replacing an item if it is so faulty that it is better to condemn than to repair it, and (3) a prorated share of all indirect costs of maintaining the depot. The Air Force currently prorates indirect costs in proportion to the acquisition cost of each item. As a result, for costly items like critical avionics components in the F-16, the depot price charged for depot repair tends to be almost three times as high as the direct repair costs and can be much higher.

Decision: Where to Screen Apparently Faulty Components Before Repair

When a fault occurs on an aircraft, a component is often removed and sent for repair. Under a new "two-level maintenance" policy, the Air Force now repairs almost all avionics components for the F-16 at the depot. Thus under DMRD 904, a user command with F-16s must pay the depot command to repair every F-16 avionics component sent to the depot for repair. But users know that not all components removed from an aircraft for repair are in fact faulty. With the right equipment and personnel, apparently faulty components can be screened on base. If they cannot duplicate (CND) the fault experienced in the aircraft when a component is screened, they assume that the component is not faulty and return it to their own inventory rather than sending it for depot repair. Such "CND screening" allows a user command to avoid paying the depot command for repairing items that in fact do not require repair.¹ CND screening before repair makes sense. But should the screening occur on base or at the depot? This question focuses on two issues: (1) Does the location of screening affect the availability of aircraft at the user command? (2) Does the location of screening affect the Air Force's cost of providing any level of aircraft availability? Typically observers expect some improvement in availability with screening on base. Thus from an Air-Force-wide perspective, the question of where to locate screening turns on whether the improvement in availability is large enough to justify any additional cost to the Air Force as a whole from locating the screening on base.

CND screening requires assets (i.e., an avionics intermediate shop (AIS) and technicians to staff it) that one depot can utilize far more economically than the many bases that use F-16s. As a result, even when we consider the transportation cost of sending all apparently faulty components to a central depot for screening, the annual, variable cost of screening on base is almost five times as high as screening at a central depot. Thus screening on base can be justified only if aircraft availability is increased enough to justify the corresponding increase in cost.

This information is precisely the kind that internal transfer prices are meant to convey—cost information that helps a local decisionmaker inside a large organization to promote the goals of the organization as a whole. As currently formulated, depot pricing in the Air Force gives the user command information and incentives that do not reflect the Air Force's broader interests. As a result,

¹CND screening is not perfect and, for a variety of reasons, can fail to detect a fault in a bad component. Nonetheless, it is good enough for a user command to value its ability to detect many items that in fact are not faulty.

(1) CND screening in all likelihood is located in the wrong place—on base—and
(2) the Air Force has had to use costly, high-level administrative procedures to
manage a small resource issue that a suitable pricing scheme should have
resolved routinely at a much lower level within DoD.

What Went Wrong?

Two problems are important. First, the depot pricing system established under DMRD 904 does not reflect the true costs of the depot system relevant to this location decision. Second, the user command has strong incentives to underestimate its own costs of screening on base. Taken together, these factors create strong incentives to place CND screening on bases even though it would cost far less if conducted at the depot. Also it would not enhance aircraft availability enough to justify this cost difference. The current depot pricing system fails in three ways.

First, CND screening is not priced separately. Rather, the same price is charged for (1) screening an item, discovering it is not faulty, and returning it to inventory and (2) screening the item, repairing it, and returning it to inventory. This price is based on an average of the depot's costs for executing these two sequences. Because screening costs only about a third as much as screening and repair together, the depot includes far more than its actual direct costs of screening in the price for items that need only be screened. This problem generates information that shows that the depot's cost of screening is higher than it is in actuality.

Second, with this approach indirect costs are allocated without determining what portion of these costs might reasonably be linked to a specific service. Specifically, when the amount of a service offered changes, what happens to the indirect activities including transportation, warehousing, administration, etc., associated with that service? Failing to ask this question misrepresents the full effects of offering a service on the depot's total costs. Whether the distortion over- or underestimates the depot's costs probably differs from case to case. The current system of allocating indirect costs in proportion to acquisition cost probably overstates the depot costs relevant to servicing high-cost avionics components.

Third, some—maybe most—indirect costs bear no relationship to servicing depot-level repairables, much less CND screening. To the extent that changing the level of screening does not affect the levels of these indirect depot costs,

including such costs in the depot price for screening generates information that shows that the depot's cost of screening is higher than it is in actuality.

Even if these problems with depot pricing were resolved, the user command still has a strong incentive to underestimate its own costs. If the user command can get authority for the resources required to perform CND screening on base (most of those resources come with the funding required to pay for them), they are essentially free to the user command. This situation is true of the equipment required to conduct screening, the AIS, and the military personnel required to staff this equipment. Only the materiel required to maintain the AIS is not funded. The user command must pay for this function from its operating and maintenance (O&M) funds—the same funds it uses to pay for depot services under DMRD 904. As a result, the user command tends to compare only costs associated with O&M funds when it asks whether it makes more sense to perform CND screening or to buy it from the depot.

The message that the Air Force conveys to the decisionmaker in the user command does not indicate how expensive CND screening is to the Air Force when it is done on base; instead the current internal transfer pricing system in the Air Force conveys exactly the opposite information. This system tells the user command that screening components on base saves the Air Force money, enough money so that the user command has difficulty understanding why the depot has any reasonable basis for trying to deny CND screening resources and authority to it. Such information leads the user command to the wrong initial decision and complicates the process of reversing that decision.

What Can Be Done?

Resolving the problem of where to conduct CND screening is fairly straightforward once the facts are marshaled and the appropriate organizational processes mobilized. But this substantive problem is only one that illustrates a much broader organizational problem in DoD. As DoD attempts to rely more heavily on internal transfer prices to allocate resources internally, it will encounter similar problems again and again until the basic problems identified above are resolved:

1. Prices must be flexible enough to fit specific services sold.
2. Prices should reflect relevant direct and indirect costs appropriately.
3. Truly fixed costs should be recovered in a way that does not distort information about costs relevant to decisions inside DoD.

4. All costs relevant to DoD should bear on the decisions that internal transfer prices are meant to support.

So long as indirect costs are allocated to the prices of services arbitrarily, truly fixed costs grossly distort prices; and the costs of military construction, procurement, and military personnel are not important to cost comparisons, an internal transfer pricing system cannot support local decisions that are consistent with DoD's broader goals.

To resolve these problems, DoD needs to approach internal transfer pricing differently. It must state clearly that its pricing system should promote cost-effectiveness as seen from DoD's perspective and that specific decisions about the implementation of the pricing system should be tested conceptually and then with experiments against this goal. The CND screening decision discussed here can be understood as one such natural experiment that was conceived as part of a transition program that should be planned and conducted more formally to promote effective implementation. Such a view suggests that we should resolve the problems of CND screening not simply by mandating the right substantive outcome in this particular case but by seeking an internal transfer pricing system that can induce the right substantive outcome in this case and presumably in others.

DoD should take advantage of the extensive experience with the existing internal transfer pricing in large, complex organizations. Formal principles and methods exist for linking a pricing system to an organization's strategic goals. Other principles and methods exist for identifying the costs relevant to specific decisions within an organization and building those costs into an effective pricing regime. Experience with multipart, marginal-cost-based prices offers important insights into how to link costs and prices. The new practice of activity-base costing, which links indirect costs to specific services offered, offers additional insights. An approach to internal transfer pricing that exploits this experience is likely to support DoD's strategic goals more effectively than the approach it is currently struggling to implement.

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Joseph DeVecchio and Grover Dunn of the Air Staff provided helpful details on the plans for and current operation of the DBOF in the Air Force. Odgen Air Logistics Center provided cost and pricing data quickly when requested. We also benefitted from unpublished work on stock funding at RAND by Lionel Galway and Timothy Ramey. Bridger Mitchell provided a thorough review. We thank them all and retain full responsibility for any errors of fact or interpretation.

Acronyms

| | |
|------|------------------------------------|
| ACC | Air Combat Command |
| AFMC | Air Force Materiel Command |
| AIS | Avionics intermediate shop |
| CND | Cannot duplicate |
| DBOF | Defense Business Operating Fund |
| DLR | Depot-level reparable |
| DMRD | Defense Management Report Decision |
| DoD | Department of Defense |
| FAC | Forecast acquisition cost |
| LRU | Line replaceable unit |
| NSN | National stock numbers |
| O&M | Operating and Maintenance |
| OSD | Office of the Secretary of Defense |
| SRU | Shop replaceable unit |

1. Introduction

In the past, Air Force users did not pay for components repaired by Air Force depots. Now they do. In November 1989, Defense Management Report Decision (DMRD) 904 mandated that the Air Force should apply stock funding to the management of depot-level reparable (DLRs).¹ To use such a fund, the Air Force must establish a system of internal transfer prices for depot services. The Air Force issued an implementation plan for such a system in November 1990 and is continuing to put it in place.² This report examines the effect of the internal transfer pricing system being used for DLRs on the decisions of officials who use these components in the Air Force's major commands.

In principle, the system used to construct a price for repairing of a DLR is similar to the system used by the Air Force in the past to construct prices for depot-level consumables, which the Air Force has managed with stock funding for many years. The price for a consumable reflected the associated depot costs—its acquisition cost plus a surcharge designed to recover storage, transportation, and administrative costs associated with its management in the depot system.

Applying this approach to reparable yields a "standard price" equal to the sum of the forecast acquisition cost (FAC)³—the estimated cost of acquiring an item new—and a surcharge to cover all other depot related costs. But with a reparable, the depot now has two potential sources of reparable—new acquisition and items returned to the depot for repair. An item returned for repair is worth an amount equal to the cost of an item acquired new, less (1) the cost of repair and (2) because the item may have to be condemned and replaced,

¹A stock fund is a revolving or working capital fund. When an activity in the Department of Defense (DoD) provides a service to another organization, it draws the fund down to pay for the resources required to produce this service. Then it charges a price for its services. Revenue received for services enters and renews the fund. When a stock fund works properly, it sustains a stable level over time. Revenues just cover costs; thus no outside funding is required to pay for the activity, and no excess revenues accumulate in the fund.

²The Office of the Secretary of Defense (OSD) and Air Force actions are documented in Department of Defense (1989) and Air Force (1990). Some observers associate these changes with the implementation of the Defense Business Operating Fund (DBOF). DBOF is the product of DMRD 971, which called for Department of Defense (DoD) to consolidate all service stock funds so that the OSD could act as the sole cash manager in DoD. This arrangement also gives OSD visibility over service operations and authority to set policy on stock funds that it would not otherwise have. In this report, we focus almost entirely on issues associated with the stock funding of DLRs per se, not the consolidation of such stock funding under OSD management.

³The FAC reflects recent procurement experience and does not include first-destination transportation costs.

the expected replacement cost if it is condemned. For example, a "net price" can be defined that defines how much the depot is willing to pay users for reparable returned to the depot for repair or condemnation and disposal.

In effect, a user sending a DLR to the depot for repairing and receiving another in exchange pays the difference between the standard and net price for this service. This "exchange price" equals the sum of (1) the expected cost of repair for the component, (2) a contribution to a sinking fund to buy a new component if the one returned is condemned, and (3) a surcharge to cover all the storage, distribution, transportation, management and other costs of handling the component in the wholesale support system. The exchange price is designed ostensibly to reflect the cost that the Air Force incurs each time a base turns to the wholesale system for support. Consumables do not require such a net price, because users never return consumables to the logistics system for repair.

Table 1 illustrates the effective cost of sending a component to the depot for repair based on these definitions. It reports data on the seven most critical line replaceable units on the F-16.⁴ Note that the exchange price charged for depot repair under stock funding tends to be almost three times the actual cost of depot repair. This price is a result of how stock funding calculates the surcharge that it uses to recover depot costs other than repair costs.

Table 1
Constructed Stock Fund Prices for Seven Critical F-16 Components

| Component | Forecast Acquisition Cost | Depot Repair Cost | Surcharge to Cover Other Depot Costs | Standard Price | Net Price | Exchange Price |
|-----------|---------------------------|-------------------|--------------------------------------|----------------|-----------|----------------|
| DFLCC | \$ 96,262 | \$ 6,859 | \$ 5,576 | \$101,838 | \$ 89,403 | \$12,435 |
| INU | 116,306 | 10,405 | 6,737 | 123,043 | 105,901 | 17,142 |
| DO HUD DU | 105,617 | 2,565 | 6,118 | 111,735 | 103,052 | 8,683 |
| PSP | 287,192 | 4,033 | 16,637 | 303,829 | 283,159 | 20,670 |
| ECIU | 108,559 | 11,769 | 6,289 | 114,848 | 96,790 | 18,058 |
| MLPRF | 244,976 | 5,544 | 14,191 | 259,167 | 239,432 | 19,735 |
| DMT | 213,591 | 6,469 | 12,373 | 225,964 | 207,122 | 18,842 |

SOURCE: Ogden Air Logistics Center, 1992a, and personal communication.

NOTE: These prices are constructed from the stock fund rules using the following assumptions:

1. The condemnation rate for such high-cost items is so low that we can assume it is zero.
2. Exchange price = repair cost + surcharge.
3. Surcharge = $0.0983 \times 0.5893 \times (\text{forecast acquisition cost})$. Chapter 2 explains the basis for this formula, which prevails for F-16 avionics components under two-level maintenance today.
4. National stock numbers (NSNs) used for these components are DFLCC, 6615-01-316-7226; INU, 6605-01-256-2380; DO HUD DU, 1270-99-746-8162; PSP, 1270-01-256-6538; ECIU, 1290-01-322-3711 or 1290-01-297-8068; MLPRF, 1270-01-233-0011; and DMT, 1270-01-238-3662.

⁴Criticality rises as acquisition cost rises and mean time between demands on the depot falls.

Proponents of using stock funding to manage DLRs expect it to improve the Air Force support system in five ways:

1. By forcing users to pay for depot services, it encourages them to use local resources for repair and to ensure that components returned to the depot in fact require repair.⁵
2. By giving users a credit for any nonobsolete component that they return to the depot, it encourages them to return reparable.
3. By allowing the wholesale logistics system to use revenues generated by "sales" to users to procure new components, it increases that system's flexibility when it chooses whether to condemn and replace a component or to repair it.
4. By generating information that highlights the costs associated with handling a component in the wholesale logistics system, it improves cost consciousness relevant to decisions like those associated with items 1 and 3.
5. By effectively placing funds for depot repair into the accounts of users, who typically receive higher priority in budgeting negotiations, it increases the probability that programmers and budgeters will adequately fund depot-level repair activities.

To evaluate the performance of stock funding, we must ask not only whether it promotes these goals but also whether, in doing so, it promotes the system-wide cost-effectiveness⁶ of the Air Force. No DMRD can be judged in isolation. Whether or not the DMRD is successful on its own terms, it is a true success only if the Air Force as a whole is benefitted.

To judge the system-wide effects of DMRD 904 on the Air Force, we must examine the actual implementation of stock funding for DLRs in the Air Force. A recent dilemma about how best to manage the repair of F-16 avionics components offers useful insights into the kind of problems that may arise during that implementation. The Air Combat Command (ACC) believes that it can save money by screening F-16 avionics components that apparently failed at the base before being sent to the depot for repair. This screening will determine whether they actually require depot repair. The Air Force Materiel Command (AFMC), which manages the depots, contends that it can perform such screening

⁵Proponents of DMRD 904 in particular expect it to yield a 10-percent reduction in demands on the depot. It is too early to assess progress toward that specific goal.

⁶In this report, "cost-effectiveness" is used to reflect both performance and cost. Hence, cost-effectiveness rises if a change improves performance while total cost remains fixed or reduces total cost while performance remains fixed.

more cost effectively. This difference in views results from using stock funding to manage DLRs and, in particular, from using prices like those in Table 1 to charge ACC for depot repair of avionics components while not charging them for important repair resources at the base. Disagreement results from using prices and a budgeting system that discourage decisionmakers from recognizing and acting on accurate information about the costs of their options to the Air Force as a whole.

This report examines this difference of opinion and draws implications relevant to stock funding for DLRs in general in the Air Force. Understanding the development of this situation can help in understanding the broader class of problems associated with implementing stock funding in a way that yields (1) a proper allocation of workload and resources between bases and depots and (2) useful information on the costs of the wholesale logistics system. We address these items in terms of how stock funding affects cost-effectiveness in the Air Force as a whole. This situation does not raise issues associated with the other goals of stock funding—encouraging the return of reparable to the logistics system, increasing flexibility to choose between repair and replacement of reparable within the wholesale system, and increasing the probability of achieving an adequate level of funding for depot-level repair.

Chapter 2 describes the component screening issue in greater detail. It explains how stock funding, as being implemented in the Air Force, encourages ACC to pursue a policy that is not beneficial to the Air Force as a whole.

Chapter 3 steps back from this example and asks how the Air Force should manage the exchange of components between users and the depot system, focusing on how such exchange affects system-wide performance in the Air Force.

The information in these chapters leads us to the conclusion that DoD's internal transfer pricing system would benefit substantially from being approached in a different way. An appendix provides summary information on three costing and pricing methods that can be used to support more effective internal transfer pricing within the Air Force.

2. CND Screening: An Example of How Stock Funding Affects Decisions

Should ACC screen components before sending them to the depot for repair? Or should an AFMC depot screen these components as they arrive at the depot? The resources involved in this decision are small relative to the total that the Air Force spends to maintain the readiness in the force each year. But the nature of the decision is representative of a much broader range of decisions that Air Force managers must make.

This section first describes the current situation, laying out ACC's view and the Air Force-wide implications of pursuing ACC's recommended course. It then explains why a policy that appears entirely reasonable to ACC under stock funding has adverse consequences for the Air Force as a whole.

Where Things Stand

The Air Force currently uses a three-level maintenance concept for most aircraft maintenance. The concept includes (very roughly) organizational maintenance at the squadron flight line, intermediate maintenance of line replaceable units (LRUs) in a shop typically collocated with each wing on a base, and depot maintenance of shop replaceable units (SRUs) at one of the Air Force's five depots. Studies by RAND and the Ogden Air Logistics Center have suggested that the Air Force could reduce costs and improve performance by moving to a two-level concept for high-cost items like avionics.¹ This concept basically moves most intermediate shop activities to the depot, retaining a small share at the base. With enhancements, including faster transportation, handling, and processing, the depot could offer the same support provided under a three-level system at a lower total cost, despite the higher costs associated with these enhancements.² On the basis of such studies, the Secretary of the Air Force approved a plan to adopt a two-level concept for these items in the summer of 1992.

¹See, for example, Abell and Shulman, 1992; Ogden Air Logistics Center, 1992.

²This example is of a situation in which an increase in the use of one input—transportation—can reduce the use of others—repair assets—enough to save money and improve total system performance. Narrowly focused initiatives like DMRD 915, which advocates a reduction in the cost of second-destination transportation in DoD, miss such opportunities for system-wide improvement.

At about the same time, the Air Force was beginning to implement the stock funding of DLRs. As noted above, stock funding charges wings for any components that they have repaired at a depot. Stated simply, stock funding encourages wing commanders to use local resources to avoid reliance on a depot if it is cost-effective for the wing commander.

In a sense, the implementation of these two policies collided at ACC with unexpected effects. ACC received FY93 monies to pay for depot repair based on an assumption that ACC would continue to use a three-level maintenance concept. When a two-level concept for F-16 avionics was implemented, the amount of money ACC would have to pay the depots increased dramatically. Although ACC repaired about 90 percent of its LRUs that needed repair under the three-level arrangement, it would rely solely on the depot for such work in the future. The magnitude of the surcharge made the stock fund price for a repair far higher than the cost of repairing an LRU on base. As a result, the ACC budget was not nearly large enough to pay for the depot repair that would be required under the new concept.

As downsizing continues, unallocated money is not easy to find in the Air Force. ACC looked for a way to reduce the amount it would have to pay the depot. During an early test of two-level maintenance, it noticed that the depot could not duplicate the failures claimed for about 28 percent of the LRUs sent to them for repair; that is, the average CND (cannot duplicate) rate was about 28 percent (Ogden Air Logistics Center, 1992b). The depot takes no repair action in such cases.³ Stock funding, however, makes ACC pay the same amount whether a repair occurs or not. ACC receives the net price for each component sent to the depot and pays the standard price for each component received, regardless of whether or not these transactions involve a repair action at the depot. ACC reasoned that, if it could identify items that the depot would rate CND, it could reduce its expenditures for depot services without reducing its capability at all. This kind of thinking is precisely what stock funding was designed to encourage.

Specifically, ACC reasoned that it could use capabilities offered by its avionics intermediate shop (AIS) to screen components before sending them to the depot to be repaired. The two-level concept contemplated that the bases would give up this capability and rely on a similar capability to be located at a depot. ACC proposed to retain a full string of 4 AIS test stands and 14 military technicians to

³A CND can point either to a false positive, indicating that initial assessment of a failure at the base was incorrect or to the depot's inability to detect a true failure in the component. Historical data indicate that both factors are important in CND ratings. An item that appears to fail repeatedly in flight ultimately must be repaired, even if routine diagnostic efforts cannot duplicate the failure. Hence, over the long run, the CND rate provides an upper bound on the proportion of components that a base can avoid sending to the depot.

operate them at each base. Given the reduction that this capability would allow in payments to the depot and the fact that ACC would not have to use its operating and maintenance (O&M) funds to pay for the technicians and test stands, this capability was worth its incremental cost to ACC.

What might make sense for ACC, however, did not make sense for the Air Force as a whole. Because AIS capabilities maintained at the depot could be utilized more fully than those located at each ACC base, it would be far more cost-effective to screen for CNDs at the depot than at individual bases. This point is illustrated in Table 2 with some sample calculations based on screening for CNDs at four air bases rather than at a single depot. It uses conservative assumptions to make the point.

The first column shows how much the Air Force would save if screening could reduce the number of components sent to the depot by 30 percentage points, a number chosen to be above the actual CND rate observed in early two-level tests. The numbers reflect a reduced need for 8 technicians, 2 test stands, and 30 percent of the transportation expense associated with sending components to the depot.⁴ The second column shows what the Air Force would have to spend to maintain the base AIS capabilities required to do this screening at each of the four bases. The final column shows the net results. Poor utilization of the AIS capability at bases leads to large losses for the Air Force as a whole. The cost would be even higher if screening at bases reduced demand for depot services by less than 30 percentage points or labor and materiel cost more.

Table 2
Cost of Screening for CNDs on Base Rather Than at the Depot

| | Depot Yearly Cost Savings | Base Yearly Cost Increases | Net Increase |
|----------------|------------------------------|-------------------------------|--------------------|
| People | \$320,000 | \$2,240,000 | \$1,920,000 |
| AIS materiel | 150,000 | 1,200,000 | 1,050,000 |
| Transportation | 249,000 | | -249,000 |
| | <u>\$719,000</u> | <u>\$3,440,000</u> | <u>\$2,721,000</u> |

ASSUMPTIONS:

1. Four bases with 72 aircraft, 1 string of AIS, and 14 AIS technicians on each base.
2. Perfect screening for CNDs, resulting in a drop in demand on the depot of 30 percentage points, which releases demand for 2 AIS stands and 8 people.
3. Annual manpower cost is \$40,000 (does not reflect training).
4. Annual AIS materiel cost is \$75,000 per stand.

For a more detailed discussion of these assumptions and their justification, see Abell and Shulman, 1992.

⁴These numbers are based on a simulation described in Abell and Shulman, 1992.

Compared to other issues that the Air Force must address in its post-Cold-War reconfiguration, the location of CND screening is not a major issue. In some senses, it is precisely the kind of routine production decision that an internal transfer pricing system should be designed to manage without incident. In this case, however, the issue was elevated to the four-star level, where representatives for ACC, AFMC, and the Air Staff have had great difficulty resolving their differences. Because the current pricing system has led these entities to view the Air Force's costs associated with screening in very different terms, it may actually have hampered their efforts to put this small resource issue behind them and get on to the genuinely more difficult and pressing, high-level policy issues that deserve their close attention. Diverting them from such issues may be one of the larger, if least measurable, costs to the Air Force of a pricing system poorly designed to support routine decisions.

How Did This Happen?

One principal goal of stock funding is to generate information about costs and to publish it in the form of prices that can be used by local decisionmakers, like wing commanders. If these prices are calculated properly, they embody information about cost, elsewhere in the Air Force (or DoD or the economy, for that matter) that a decisionmaker can compare with his own information on the costs of local options and choose options that are cost-effective for the system as a whole. Stock funding of DLRs led ACC to make the wrong choice for the Air Force as a whole for two reasons:

1. The price set for using depot services through the stock fund did not reflect the true costs to the Air Force of providing those services.
2. ACC did not consider all the relevant costs when calculating the cost of maintaining an AIS on each air base.

Because the stock fund price led to a gross overestimate of depot costs and accounting procedures led to an underestimate of base costs, it was easy for ACC to conclude that maintaining AISs on each base made sense.

Overestimating Depot Costs

Three aspects of stock fund pricing contribute to an overestimate of depot costs.

First, the decision in question concerns screening, not full repair. Screening is a separable activity that typically accounts for less than a third of the cost of the full repair of an LRU. The stock fund price is based on the expected cost of

dealing with any item that arrives at the depot; it is effectively a weighted average of the cost of screening items that do not require repair and of screening and repairing items that do require repair. As a result, users pay more than the cost of depot screening when only screening is required. A price designed to support the decision of where to place screening would reflect only the cost of screening and would exclude costs associated with repair. Under stock funding, the Air Force potentially could unbundle screening and offer depot screening as a service separable from depot repair. If an item did not require repair, the depot would return it to the user, who would simply pay for this service. If it did require repair, the item would enter the depot repair system, and the process would proceed as described in Chapter 1. In such an approach, the price of each service would reflect its own expected cost.

Second, the surcharge would not reflect nonrepair costs relevant to this transaction even if it were applied only to the depot cost of screening for CNDs. In the initial implementation of stock funding, the Air Force calculates the surcharge almost arbitrarily. It starts with the forecast acquisition cost of a component to be distributed to users, either new or repaired. It calculates the total amount the wholesale system would receive if it "sold" all components to users at this price; call this total A. It then calculates the total costs of storage, distribution, transportation, management, etc., in the wholesale system. It adds the cost of replacing condemned components; call this total B. Then it calculates a surcharge factor, B/A , that it applies to the forecast acquisition cost of each component distributed to determine the absolute surcharge for that component. The current value of that factor is about 9.83 percent.⁵ It provides no information on the specific costs of managing, transporting, or replacing condemnations for a specific component. Its principal virtue is that, in aggregate, it covers such overhead costs out of "sales" to users. Covering overhead costs is not the same as providing local decisionmakers with the information they need to promote the Air Force's interests; useful information for accountants is close to irrelevant to local decisionmakers.⁶

Third, even if we found some more reasonable way to allocate overhead costs to the prices of specific services, these costs remain overhead costs. They are

⁵Note that this figure is 9.83 percent of the cost of acquiring a new item—not repairing an existing item. As Table 1 indicates, this factor has been reduced by 0.5893 for F-16 avionics components repaired under a two-level concept. This reduction was negotiated to relieve the budgetary shortfall at ACC described in the text. Even following this adjustment, depending on the relative costs of new items and repair services, the surcharge easily can exceed the expected repair cost by a large amount.

⁶Air Force officials are aware of this criticism and are seeking ways to deal with it by developing, among other things, a way to calculate a surcharge that more nearly reflects costs relevant to individual components. They have anticipated this problem from the beginning; however, they believe that under the new system the data required to implement a more targeted surcharge will take several years to accumulate.

essentially fixed with respect to decisions about individual activities like screening avionics for CNDs. Changes in such activities are unlikely to have much effect on general management costs in the wholesale system. If a stock fund is to be self-financing—if it is to generate all revenues from “sales” to users—it must recover such overhead costs in the prices that it charges. The prices that result, however, do not reflect the variable costs to the depot of providing a service. Because variable costs indicate the effects of a decision on the Air Force as a whole, the presence of any surcharge to cover fixed costs inherently reduces the information value of such prices to local decisionmakers trying to do the right thing for the Air Force as a whole.⁷

Any one of these factors taken alone could induce a substantial overestimate of the costs of screening at the depot relevant to the Air Force as a whole. Taken together, they yield a gross overestimate.

Underestimating Base Costs

Stock funding is designed to enhance a wing commander's flexibility by allowing him to split his expenditures between activities on base and at a depot in a way that yields the best performance for his base. But the commander's flexibility is still severely limited. For example, he cannot directly reduce expenditures on military personnel on base to free up funds for the depot. Similarly, he cannot cut expenditures at the depot knowing that he can use the freed-up funds to buy major equipment that will allow him to perform activities on base instead. Because monies that he might spend at a depot come from O&M funds, he can only use such monies to buy goods and services that these funds can buy. As a result, the costs of such goods and services are the main concern of a wing commander when he chooses to spend monies from his O&M budget at the depot or on base. He tends to discount the costs of military personnel, facilities, equipment, and research and development associated with base operations in these decisions.

In our example, placing AISs with their associated military manpower on base does not affect the available funds that the wing commander has to buy services from the depot. In a sense, getting access to these resources can only reduce the difficulties a wing commander experiences when he is short of O&M funds needed to buy depot services. He will have to pay for materiel to maintain an AIS from these funds, but essentially the manpower comes for free. Military

⁷What cost is and is not fixed in any situation depends on the planning horizon. This decision has generated great controversy in cost accounting circles for years. The appendix examines this issue.

manpower and the facilities and auxiliary equipment associated with CND screening on an air base obviously are not free to the Air Force. Until wing commanders can view such costs on equal terms with O&M costs, stock funding will tend to encourage them to reject depot services, even when such services are cost-effective for the Air Force as a whole.

Implications for Other Decisions

The success of internal transfer pricing systems depends ultimately on how well they help decisionmakers within an organization weigh the options they face. We can expect the kinds of problems discussed in terms of this specific example to appear wherever a pricing system like that used under DMRD 904 is applied in the Air Force or any other part of DoD, because that pricing system will treat the relevant options similarly.

Until DoD explicitly recognizes that prices are designed to affect behavior and not only to move responsibility for justifying funding in the budgeting process or to reconcile accounting aggregates, we can expect mismatches between the way services are bundled and priced and the decisions that they affect. In fact, these mismatches will continue until cost accounting systems are changed to accumulate enough data to identify costs relevant to the decisions in question. In part for similar reasons, we can expect great difficulty in matching indirect costs to prices that support decisionmaking effectively. These problems can be handled within the current pricing system if officials responsible for setting prices recognize the central importance of supporting decisionmaking.

More difficult to address will be the problem of recovering the costs of activities whose levels do not vary with the level of any individual product that a DoD organization produces and sells to other organizations. How to recover such "fixed" costs through internal transfer prices without distorting decisions is a pervasive problem. It probably will arise wherever prices like those discussed here are implemented.

The problem of recovering fixed costs may be greatest in organizations that deliberately maintain core functions that experience low demand during peacetime in anticipation of a surge, reconstitution, or wartime requirement. To the extent that wartime requirements truly justify such core functions or excess capacity serves a purpose in DoD that is separable from the services offered routinely in peacetime. With the current pricing system, it is extremely difficult to separate costs in an organization associated with such wartime and peacetime missions, in part because DoD has been reluctant to make such distinctions clear in its existing accounting systems.

The funding distinctions that Congress makes between resources used for military construction, procurement, military personnel, O&M, etc., can be expected to distort the incentives of any organization that uses significant funds other than O&M funds and has the option of buying services from another DoD organization at prices designed to recover all the costs of that other organization. This problem pervades DoD. Probably it will be most serious in the kind of example examined here, where a military command, in which military personnel costs dominate variable costs, buys such services from another organization. DoD has plans to expand its stock funding in a way that would create this difficulty wherever military units use services from other organizations.

Hence, the example used here is not unique. In many important ways, it is representative of the kind of decisions that stock funding can affect throughout the Air Force and DoD as a whole.

Summary

In sum, stock funding of DLRs encouraged ACC to pursue CND screening, despite its negative effects on the Air Force as a whole. This problem arose because stock funding did not perform two functions that advocates of stock funding claim it would do.

1. It did not provide useful visibility for costs relevant to the decision. On the contrary, the stock funding prices that ACC decisionmakers had to work with bore little relation to the costs relevant to this decision.
2. As a result, local decisionmakers could not allocate resources in a way that benefited the Air Force as a whole.

The resources at issue here are minor; the questions raised have much broader applicability.

3. Lessons for the Future

Although it has been a pressing concern to the parties involved, the problem of where to screen components for CNDs is small relative to the Air Force's broader concerns about the cost effectiveness of its support structure. But it teaches us three important lessons that are relevant to broader concerns about the support structure:

1. To appreciate the actual effectiveness of stock funding of DLRs, we must ask how it affects the performance of the Air Force as a whole.
2. Stock funding of DLRs is a major change in practice. The Air Force should expect it to be difficult to implement and plan for the costs of transition.
3. To be effective, stock funding of DLRs ultimately must support and improve specific decisions within the Air Force support structure.

Maintain a system-wide perspective. Because the DMRDs have been implemented as individual initiatives, with individual goals for cost savings, it is tempting to judge each on its own terms, without reference to the others. In the end our substantive interest is not in these DMRDs but rather in the performance of the Air Force (and the remainder of DoD).

At a fairly high policy level, effective implementation of stock funding actually could increase second-destination transportation expenses. Successful implementation of DMRD 904, which focuses on stock funding, might occur at the expense of DMRD 915, which focuses on transportation costs. If the cost-effectiveness of the Air Force rises as a whole, however, it is really only a secondary concern that perhaps DMRD 904 succeeds and DMRD 915 does not. One principal lesson of the quality movement sweeping through private manufacturing is that optimization relative to individual functions like transportation often reduces the performance of the system as a whole. Only through an integrated view of change can we seek to improve the Air Force as a whole.

At a lower, more operational level, stock funding can improve the performance of the Air Force as a system only if it generates information that supports a system-wide perspective. A local decisionmaker inside the Air Force must act on the basis of the information given to him. Normally, we can expect him to know more about his local situation than about activities elsewhere in the Air Force; the

prices used in stock funding are meant to provide useful information about the rest of the system. If these prices do not provide accurate information or the information provided is not commensurable with a decisionmaker's information about his local situation, stock funding does not support a system-wide view. Such prices, offered to support "business-like" operations under stock funding, can lead decisionmakers to believe they have precise cost data and thereby easily lead them to make precisely the wrong decision for the Air Force as a whole. This report offers one example of such a case. We return to this theme below.

Anticipate and plan for the transition. That transition is costly is not news to DoD. It is commonplace to read about the costs of cleaning up DoD installations before closing them and converting them to nondefense use. We hear about the costs of decommissioning and destroying stocks of strategic weapons. Defense contracts routinely include language that specifies the obligations of the parties if a contract is terminated. DoD recognizes that termination can impose substantial costs on both parties. DoD officials planning to implement the stock funding of DLRs did not allow for any comparable costs of transition to accompany this major policy change. Without plans for a transition, the problems that inevitably arise probably are more disorienting, impose greater costs on DoD, and prolong the transition to effective implementation longer than necessary. Although the Air Force cannot change plans not made in the past, it can recognize the inevitability of a transition, with its associated costs, and plan within its means for that transition now.

One of the most important elements of transition will be the exposure of places where stock funding leads to perverse incentives or outcomes. The case examined here offers an example. Any major change in policy must be adjusted as its practical implications become better understood. For example, until the stock funding and two-level maintenance concepts were juxtaposed in application, the question of where to perform CND screening was not a significant concern to the Air Force. Hence, it would be unrealistic to expect the Air Force to have a system in place to deal routinely with this concern. High-level management attention was required to address the issue. We can expect this experience to be repeated as other conflicts between major commands, induced by a transition that changes the questions that interest those commands, come to light.

Potentially high-level managers can resolve a problem like CND screening in a variety of ways. For example, once they are satisfied that screening at the depot is most effective from an Air Force-wide perspective, potentially they can effect that change by simply imposing a policy that places screening at the depot, by removing AIS capability from the bases, by sealing avionics boxes so that they

cannot be screened on base, or by some other means. Such a decision will resolve this issue but not the others to come. During the transition, high-level managers should be looking for ways to get this kind of decision off their calendars and back to the operating level where they should be resolved under stock funding. They should use the transition not just to resolve specific issues like CND screening but to seek an internal pricing system that will work as advertised over the long run.

Develop internal transfer prices that effectively support specific decisions.

Internal transfer pricing is common in the private sector, where it is designed to raise the visibility of costs inside an organization and encourage decisionmakers to make sound decisions about their use of services provided inside the organization. The example we have examined here illustrates a situation where the pricing used bears little or no relationship to the decision in question. In particular:

1. To be effective, internal transfer pricing must focus on specific services exchanged. Stock funding, as currently implemented, offers no way to reflect the cost of screening components per se.
2. The services exchanged within a large, dynamic organization change repeatedly, requiring flexibility for internal units to negotiate with one another over the forms of transfers and their associated prices. This case is especially true when the organization operates in a dynamic environment and must adjust its operations and perhaps its structure repeatedly to maintain its effectiveness. Stock funding, particularly as implemented under a centralized DBOF concept, is not flexible enough to respond to the many decisions that arise routinely within such a large, complex organization.
3. Flexibility is important in a transition, but the need for flexibility will persist over the long run. Most observers agree that, although the external threat is lower, it is also less certain than it was in the past. We can expect the Air Force to reorient itself repeatedly as it addresses one new threat or another. In addition, experience in the private sector points to more rapid development and absorption of new technical options. To support decisions in such an environment over the long run, internal prices will have to promote even more flexibility than has been needed in the past.

The current system of standard and net prices makes it very difficult to unbundle any specific service to allow competition between the base and depot for that service. This fact may be one reason why such a system of internal transfer prices is not common in the private sector. Stock funding, as currently implemented to support decisions on maintenance in the Air Force, cannot

legitimately be called a business practice. The Air Force does not emulate efficient operations in the private sector when it uses such a device. Rather, the standard and net prices of stock funding are inherently awkward inventions of government accountants who give insufficient attention to the importance of internal transfer prices that support the real decisions required in any complex organization.

Once the Air Force has identified a specific decision that internal pricing must support, it must seek a way for internal prices to reveal useful information on costs that promote the goals of the Air Force as a whole. Such prices should increase the likelihood that, when a local decisionmaker pursues the proximate goals used to judge his performance in the Air Force, he simultaneously pursues the broader goals of the Air Force itself. Although advocates often promote stock funding using just such arguments, it falls short in three ways:

1. Currently the surcharge is unrelated to costs relevant to individual decisions. Efforts under way could rationalize the surcharge to improve its information content.
2. Even with a perfect surcharge, whatever that might mean, unit cost pricing cannot reflect the variable costs relevant to a system-wide perspective. Currently contemplated reforms do not address this problem.
3. As long as internal transfer prices focus attention on costs paid for using O&M funding, they exclude other important cost information that could be decisive in many specific decisions. DoD wants to make DBOF prices more inclusive in the future, but wing commanders will not get the flexibility with regard to resources on base that DBOF funding allows at the depot. Hence, wing commanders will not be able to recoup the savings offered by using depot services to displace military maintenance personnel on base. Until they can, comparisons between depot and base options will be faulty, no matter how well DBOF prices reflect true depot costs.

Given these concerns, it may be worth thinking about alternative internal pricing systems. The private sector has extensive experience with such prices that should be useful to the Air Force (and DoD as a whole). Extensive theoretical work is also available on how to define prices of publicly provided services to support and improve specific decisions; such prices have been implemented effectively in many contexts. The appendix provides a brief overview of three approaches to costing and pricing that could help the Air Force support and improve specific decisions in its support structure.

In sum, it is one thing to speak abstractly about using stock funding of DLRs to increase the visibility of costs. It is another thing entirely to use stock funding as currently implemented to support specific decisions with information that promotes the goals of the Air Force as a whole. DoD is working on a number of reforms to improve the implementation of stock funding, but even these will not resolve important problems in the system. This report has used a simple but representative example to illustrate what can happen when the principles associated with stock funding are applied in practice. Our analysis suggests that the Air Force can expect similar cases in the future. We hope that this report helps the Air Force plan for such cases and develop responses to them that, in the long run, yield a system of internal transfer prices that support specific decisions effectively by promoting the interests of the Air Force as a whole.

Appendix

Cost and Pricing Concepts Relevant to Transactions Between Depots and Bases

Private firms make extensive use of internal transfer prices to facilitate the transfer of services between activities internal to firms. Effective management of large, complex firms performing many functions and selling many different products from different facilities would not be possible without them. In fact, recent studies have indicated that firms develop systems of internal transfer prices specifically designed to help implement their corporate strategies; as strategy changes, the system of pricing changes. As a result, the private sector has a rich experience obtained from using internal transfer prices. A large body of research exists on how to implement such prices.¹

Studies of practice and theory emphasize that (1) internal pricing systems must be evaluated in terms of how they affect real, specific behaviors, decisions, and outcomes; (2) to affect decisions properly, prices in a vertically integrated organization must reflect internal costs properly; and (3) effective pricing systems incorporate flexibility for the parties affected to negotiate changes and for management to adjust prices as the business environment or management plan changes. In the end, if internal transfer prices do not support the management plan fairly directly, they are ineffective.

Emphasis on the relationship between prices and costs is similar to that in the literature on the pricing of publicly provided or regulated services. That literature emphasizes that, to be effective, a public price must reflect the costs relevant to the service a customer buys when she pays the price for that service. Typically such pricing calls for multipart pricing, in which different prices apply to different aspects of the service. For example, if a customer wants only one of an item, the price reflects just the cost of providing that item with existing capacity. If the customer wants a future capability to have additional items on demand, the price reflects the cost of guaranteeing availability of future capability. Such pricing often fails to yield total revenues that exactly equal total

¹Useful introductions to the literature include Benke and Edwards, 1980, which offers a fairly standard overview of internal pricing concepts; Eccles, 1985, which surveys actual pricing systems in use and their relation to strategic intent; and Bruns and Kaplan, 1987, which documents recent research on detailed implementation of transfer pricing in firms.

costs. If it is important for costs to equal revenues (as for stock funding), prices can depart from the costs relevant to decisions in specific ways. Theory explains how to develop the cost information required to implement such pricing and how to set prices based on the cost information that results. Experience indicates that such a theory can be implemented in practice. In fact, internal transfer prices often reflect considerations very similar to those found in public pricing literature.

This appendix briefly reviews three aspects of costing and pricing that are relevant to developing internal transfer prices that effectively support specific decisions in a large, complex organization. It first examines the concept of multipart pricing. Then it describes a recent innovation in cost accounting, called activity-based costing, that improves the ability of accountants to associate costs with specific services. This method improves an organization's ability to generate multipart prices that reflect the organization's true costs. Finally, it examines how optimal multipart prices can be adjusted, if need be, to equalize costs and revenues.

Multipart Pricing

Think about a restaurant that is full during the evening and only half full during the day. Someone who wants to eat during the day essentially imposes only the cost of preparing and serving the meal but nothing further. If that same person wants to eat at night, he displaces someone else and imposes a cost equal to the amount that person would have paid to eat. The size of the restaurant should be expanded if the cost of adding and servicing an additional table is less than the cost of turning people away—that is, less than the amount they would be willing to pay to use the table over its lifetime. This kind of thinking suggests that people who eat at the restaurant during the day should be charged a price that covers only the cost of preparing and serving the meal. People who go at night should pay a price that covers not only the costs of preparing and serving the meal but also the costs of building and maintaining the restaurant itself.

Because of such thinking, the price of eating a meal has been split into two parts. One part covers the direct costs of preparing and serving a meal. That price is charged at all times. The second part—call it a surcharge—covers the cost of building and maintaining the restaurant itself. That part is charged only during the evening when the level of demand justifies the full space available in the restaurant.

More generally, it is possible to break down any set of costs and ask under what circumstances these costs change. To the extent that changes in cost can be traced to decisions by customers, components can be added to a price. To the extent that a customer demands a service that can be produced by using additional variable factors like materiel or unskilled labor, the price a customer is charged reflects only the costs of these variable factors. To the extent that the customer wants a kind of service that requires an organization to expand its investment in facilities, equipment, or skilled labor, the cost to the customer reflects the so-called fixed cost of these assets as well. Such an approach ensures that the customer is aware that his actions do affect the seller's costs fairly specifically. If the customer feels that the premium cost is justified to eat at night, for example, then it is worth the cost of adding to the restaurant to ensure that he can eat at night. In this case, his decisions reflect good information on the full cost implications of his actions.

An organization using such a pricing system comes to recognize a series of "margins" where it continually considers whether to add marginal factors—capital, labor, or materiel—to provide the services that its customers demand. A complex organization can consider decisions at many margins and develop prices or components of multipart prices to reflect the costs of the decisions that it faces at each of these margins.²

In the context of stock funding the DLRs, it is natural to differentiate the direct (apparently variable) cost of repair from the surcharge, which presumably allows depots to recover their (so-called) fixed costs. But stock funding does not attempt to make the effective prices of services reflect the actual costs of these services to the depot; the surcharge ensures that all customers contribute to the recovery of fixed costs, whether or not the services they demand affect fixed costs. Until the cost structure of the depot is broken down and the key drivers for each cost component identified, stock funding will continue to yield prices that do not provide cost information to help customers know the true effects of their actions when they demand service.

²Two excellent treatments of this approach to pricing are (1) Mitchell, Manning, and Acton, 1978, which examines the actual use of such pricing in the provision of public services in Europe, and (2) Mitchell and Vogelsang, 1992, which provides a more rigorous treatment and additional information of the application of such pricing to telecommunications services in the United States and Europe.

Activity-Based Costing

Bell Communications Research (Bellcore) recently faced a problem very much like the CND screening problem.³ Increasingly professionals were preparing their own documents or turning to outside sources to avoid outlandish internal prices for text processing and graphics services. Bellcore weighed alternatives like forcing the use of graphics services, shutting off access to outside services, etc. After considerable effort, Bellcore determined that its internal pricing system induced such behavior. It was allocating important cost categories in a way that created perverse incentives. It turned to an approach very much like that now known as "activity-based costing" to correct the problem.

Activity-based costing occurs in two major phases: (1) determine the costs of significant activities, and (2) assign the costs of the activities to products or to other 'objects' of interest, such as customers or services (Ostrenga, et al., 1992, p. 153). In effect, Bellcore defined costs in terms of traditional budget categories like salaries and benefits, equipment leases and supplies, usage-based services, nonusage-based services (library services, for example), landlord services, general and administrative, and capital-related costs. It then developed improved ways to assign these costs to relevant objects of interest—the many service centers within Bellcore that provide services like text processing, telecommunications, the motor pool, and purchasing for the rest of the organization. The repair services for particular components that depots provide to air bases might be analogous objects of interest relevant to stock funding.

Activity-based cost assigns direct costs (i.e., repair) to objects of interest in the traditional manner. Its main contribution is to improve the allocation of so-called fixed costs. For example, Bellcore focused on changing the allocation of costs in three budget categories—landlord services, nonusage-based services, and general and administrative costs—that accounted for 40 percent of total costs. It found, among many other things, that allocating the costs of laboratory and office space separately led to major improvements. Note that using laboratory space to allocate landlord service costs allows a service center to change its behavior—its use of laboratory space—to change its internal price in a way that reflects true costs to Bellcore as a whole. Such use of costs in pricing supports internal decisionmaking in the same way that the association of costs with decision margins does in multipart pricing. Because the two approaches have strong parallels, one can be used to support the other.

³This example comes from Kovac and Troy, 1989. For a practical guide to detecting such problems, see Cooper, 1989.

The result at Bellcore was a set of internal transfer prices that reflected more closely the true costs of internally provided services and hence led to a greater sense of equity within the organization. Bellcore expects the prices it identified to improve decisionmaking for now but also expects that it will have to check these prices from time to time to keep them in line with costs.

Such an approach could improve the Air Force's definition of the surcharge that currently recovers so-called fixed costs. More detailed identification of cost pools inside the depot and investigation of cost drivers in each cost pool also should improve the Air Force's ability to use multipart pricing to recover costs in selected pools. Activity-based costing is a new approach to cost accounting, but it has already demonstrated the ability to support improved pricing. Its usefulness will only increase as its application spreads and new methods are developed for specific applications.⁴

Setting Costs and Revenues Equal

On paper, the stock funding of DLRs is supposed to yield prices that yield revenues just equal to DoD's expected costs. Congress has already criticized stock funding of DLRs, among other things, for generating revenues that exceed costs.⁵ Congress wants to ensure that DoD does not use stock funding to generate excess funds that it can use without congressional control through the appropriations process.⁶ For many years public utility commissions and public agencies selling services to the public have maintained a similar goal that revenues not exceed costs by more than the amount allowed for profit.

Unfortunately, multipart pricing need not yield revenues that exactly equal costs. Under certain very special circumstances, this situation will occur without planning for it. Normally, however, it must be enforced. Cost pools can be defined so that costs equal revenues when prices are based directly on activity-based costing. The preferred approach to bring costs and revenues into line is to use a method called "Ramsey pricing."⁷

⁴The basic concepts underlying activity-based costing were proposed first in Miller and Vollman, 1985. For a recent "how-to" description of activity-based costing, see Ostrenga et al., 1992. Cooper and Kaplan, 1988, provides empirical evidence on how severely traditional cost accounting can distort cost estimates—and hence cost-based prices—relative to activity-based costing.

⁵For details, see Morrison, 1992.

⁶It is worth noting that Congress retains its ability to influence defense spending of funds associated with a stock fund through its authorizations actions. Stock funding only affects where funds appropriated by Congress enter DoD.

⁷The method is named for Frank Ramsey, an economist who first described it in the 1920s. The standard modern reference is Baumol and Bradford, 1970.

Ramsey pricing starts with a multipart price that reflects actual incremental costs as closely as possible. Such pricing determines the levels of demand at the various margins affected by the price and uses these to calculate total costs and total revenues. If costs exceed revenues, as they typically will if large, truly fixed costs exist, this method then increases prices at each margin so that usage falls by the same percentage at each margin. Such an approach minimizes the net loss that occurs when people give up services that cost less to produce than people are willing to pay for them at the margin. The result is that prices rise most at margins where demand is least sensitive to price.

In the context of the CND screening problem, suppose activity-based costing has been applied to associate as many costs as possible with specific services and multipart pricing has set up prices for as many aspects of depot services as are seemed reasonable. Suppose true fixed costs are large enough so that costs still exceed revenues. Then the prices of services would have to rise above their calculated costs to cover this fixed cost in the depot. Under Ramsey pricing, in all likelihood, prices for CND screening would not rise above the level required to keep CND screening from moving to the base. Prices would rise on other services where competition at the base was not an option, like the repair of SRUs. Ramsey pricing is highly responsive to the presence of competition and seeks to cover fixed costs by raising prices only on services that probably would not be lost to competition if prices rise. The effect is to recover fixed costs without adversely affecting decisions that are sensitive to estimates of variable costs in the depot.⁸

The flexibility that allows Ramsey pricing to recover fixed costs without adversely affecting decisionmaking often concerns public utility regulators, who suspect any pricing decision that is not based on a clearly defined formula. Congress could react the same way if the Air Force used Ramsey pricing to define internal transfer prices. Before the Air Force attempts Ramsey pricing, it should anticipate such a response and be prepared to explain that Ramsey pricing does not change the relationship between total revenues and total costs—that is Congress's principal concern. In fact, it provides a way to ensure the equality of costs and revenues while avoiding the perverse incentives created by the current system of unit cost pricing.

The approaches discussed here yield internal transfer prices far more subtle and informative than the standard and net prices associated with stock funding of DLRs. Planned improvements in the prices used in stock funding will overcome

⁸For a description of such pricing in practice, see Camm, 1981.

some of the problems experienced in the current implementation of stock funding. They will not yield internal prices that tell a local decisionmaker the true costs he imposes on the Air Force as a whole when he makes a decision. The approaches discussed here explain how private firms and public agencies currently develop prices that do provide such information to decisionmakers inside large, complex organizations.

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